

VERIFICATION

The undersigned, of the below address, hereby certifies that he/she well knows both the English and Japanese languages, and that the attached is an accurate English translation of the Japanese Patent application filed on November 18, 2002 under No. P2002-334032.

The undersigned declares further that all statements made herein of his/her own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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JAPAN PATENT OFFICE

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Date of Application: November 18,2002

Application Number: Japanese Patent Application  
No.2002-334032

Applicant(s): Shin Mitsui Sugar Co., Ltd.

Commissioner,

Patent Office

(Seal)

Document Name)Patent Application

(Reference Number) 02-1938

(Presentation Date) November 18, 2002

(Directly) Commissioner of the Patent Office

(IPC) C08B 37/00

A23G 3/00

A61P 3/10

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(Pre-Paid Master Note Number) 014708

(Amount to be paid) 21000

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(Proof Reading) Required

[Document Name] Specification

[Title of the Invention] A METHOD FOR REDUCING BLOOD  
GLUCOSE LEVEL INCREASE, A METHOD FOR REDUCING  
BODY FAT ACCUMULATION AND FOOD MATERIAL

5 [Claims]

[Claim 1] A method for reducing blood glucose level increase,  
characterized in that said blood glucose level increase is caused by  
consuming saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to  
less than 50% relative to the total bonds among constituent saccharides,  
10 and that palatinose is ingested simultaneously with consuming said  
saccharide.

[Claim 2] A method for reducing blood glucose level increase,  
characterized in that said blood glucose level increase is caused by  
consuming at least one foodstuff being selected from the group  
15 consisting of sucrose, wheat flour, starch, dextrin and high fructose corn  
syrup, and that palatinose is ingested simultaneously with consuming  
said foodstuff.

[Claim 3] A method for reducing body fat accumulation,  
characterized in that said body fat accumulation is resulted from  
20 the increase in blood glucose level and insulin secretion caused by  
consuming saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to  
less than 50% relative to the total bonds among constituent saccharides,  
and that palatinose is ingested simultaneously with consuming said  
saccharide.

25 [Claim 4] A method for reducing body fat accumulation,  
characterized in that said body fat accumulation is resulted from

the increase in blood glucose level and insulin secretion caused by consuming at least one foodstuff being selected from the group consisting of sucrose, wheat flour, starch, dextrin and high fructose corn syrup, and that palatinose is ingested simultaneously with consuming said foodstuff.

[Claim 5] A food material comprising palatinose and a foodstuff composed of saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to less than 50% relative to the total bonds among constituent saccharides, characterized in that said food material comprises said palatinose in an amount necessary to reduce an increase in blood glucose level caused by consuming said foodstuff.

[Claim 6] A food material comprising palatinose and at least one foodstuff being selected from the group consisting of sucrose, wheat flour, starch, dextrin and high fructose corn syrup, characterized in that said food material comprises said palatinose in an amount necessary to reduce an increase in blood glucose level caused by consuming said foodstuff.

[Claim 7] A food material according to Claim 6, wherein said food material is used as a sweetener and said foodstuff is at least one foodstuff being selected from the group consisting of sucrose and high fructose corn syrup.

[Claim 8] A food material according to Claim 6, wherein said food material is used as a premix material and said foodstuff is at least one foodstuff being selected from the group consisting of sucrose, wheat flour, starch and dextrin.

[Claim 9] A food material according to Claim 6,

wherein said food material is used as a powdery drink and said foodstuff is sucrose.

[Claim 10] A food material according to any of Claims 5-9, characterized in that the weight (A) of said palatinose has a ratio of 5% or more relative to the sum of the weight (A) and the weight (B) of saccharide contained in said foodstuff.

[Claim 11] A method for reducing blood glucose level increase caused by consuming said foodstuff, characterized by ingesting a food material described in any of Claims 5-10 or a food prepared by processing said food material.

[Claim 12] A method for reducing body fat accumulation, characterized by ingesting a food material described in any of Claims 5-10 or a food prepared by processing said food material.

#### [Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Pertains]

The present invention relates to a method for reducing blood glucose level increase, a method for reducing body fat accumulation and a food material.

[0002]

[Prior Art]

As a constituent for reducing blood glucose level increase, there have been known an extract from *Gymnema Sylvestre* leaves (Patent Literature 1, Patent Literature 2), an extract from *Gymnema Inodrum* (Patent Literature 3), and an extract from *Gymnema Chingen* (Patent Literature 4). They are considered to reduce blood glucose level increase

because of an effect of reducing glucose absorption. Triterpene glycoside (Patent Literature 5) contained in *Gymnema Inodrum* is also reported to have the effect of reducing glucose absorption.

[0003]

5            Monoterpene glycoside is known to have an effect of reducing blood glucose level increase through a sucrase inhibition effect (Patent Literature 6). Examples of such monoterpene glycoside include a betaine from a sugar beet (Patent Literature 7), a saponin mixture from *Alaria elata* (Patent Literature 8), and an  $\alpha$ -glucosidase inhibitor (Patent  
10 Literature 9).

[0004]

            Additionally, there has been recently reported carbohydrate having an effect of reducing blood glucose level increase. Indigestible dextrin is known to show an effect of reducing blood glucose level  
15 increase after food intake for a person with easily rising blood glucose level (Non-patent Literature 1). L-arabinose is also demonstrated to inhibit specifically the activity of small intestine sucrase which decomposes sucrose (Non-patent Literature 2).

[0005]

20            [Patent Literature 1]  
            JP Tokkai H1-85058  
            [Patent Literature 2]  
            JP Tokkai H2-79955  
            [Patent Literature 3]  
25            JP Tokkai H5-252897  
            [Patent Literature 4]



- JP Tokkai H6-245735  
[Patent Literature 5]]
- JP Tokkai H6-128161  
[Patent Literature 6]
- 5 JP Tokkai H6-100453  
[Patent Literature 7]
- JP Tokkai H8-133970  
[Patent Literature 8]
- JP Tokkai H8-283169  
10 [Patent Literature 9]
- JP Tokkai H8-289783  
[Non-patent Literature 1]
- Kenko/Eiyosyokuhin Kenkyu, Vol.5, No.2, 21-29, 2002  
[Non-patent Literature 2]
- 15 Nihon Eiyo/Syokuryo Gakkai Shi (The Journal of JSNFS), Vol.50,  
No.2, 133-137, 1997  
[Non-patent Literature 3]
- Hormone and Metabolic Research, Vol.21, No.6, 295-346, 1989  
[Non-patent Literature 4]
- 20 ILSI Europe Concise Monograph Series, [Nutrition and Health  
Aspects of Sugars, Evaluation of new findings], pp8-12, 1998  
[Non-patent Literature 5]
- Nihon Eiyo/Syokuryo Gakkai Shi(Journal of Japanese Society of  
Nutrition and Food Science), Vol.36, No.3, 169-173, 1983
- 25 [Non-patent Literature 6]
- New Food Industry, Vol.31, No.10, 9-15, 1989

[0006]

[Problem to be Solved by the Invention]

However, the Gymnema extract etc. taste so bitter as to block sweet taste, and hence can not be used without a particular treatment.

5 The indigestible dextrin and L-arabinose, though carbohydrate, are difficult to be digestibly absorbed, and sometimes cause diarrhea when they are ingested in a large amount. A substance having an effect of inhibiting sucrase activity is pointed out that, when ingested together with sucrose, it allows the sucrose to reach a large intestine without  
10 decomposition. In other words, all the above substances demonstrating the effect of reducing blood glucose level increase have various problems such as inconvenience at use and limited application.

[0007]

Therefore, a reducer of blood glucose level increase which is free  
15 from unpleasant taste such as bitter taste and which can be ingested as a safe food has been desired. Further, a plant extract is not usually ingested as food, and L-arabinose is a food additive. Therefore, a method for reducing blood glucose level increase employing a safe food material usually ingestible as food has been desired.

20 [0008]

An object of the present invention is to provide a method for reducing blood glucose level increase which can solve the above problems in the prior art.

[0009]

25 [Means for Solving the Problem]

The present inventors have made a diligent study and found out

that a combination of certain substance causing the blood glucose level increase and palatinose can be ingested, while solving the problems, to reduce blood glucose level increase caused by the substance, and have completed the invention.

5 [0010]

Namely, the invention provides a method for reducing blood glucose level increase, characterized in that the blood glucose level increase is caused by consuming saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to less than 50% relative to the total bonds among  
10 constituent saccharides, and that palatinose is ingested simultaneously with consuming the saccharide.

[0011]

As is reported in aforementioned Non-patent Literature 3 etc., palatinose is a foodstuff having a low Glycemic Index and causes no  
15 sudden increase or decrease in blood glucose level after ingestion (Glycemic Index is an index which indicates relationship between food and blood glucose level, which is in the news recently, and uses white bread or glucose as a standard food). It has been considered that  
20 palatinose is ingested simultaneously with another saccharide to express a change in blood glucose level which is a sum of the change caused by the palatinose and the saccharide. Therefore, palatinose has been only intended to be used alone as saccharide in a food for reducing blood glucose level increase.

[0012]

25 With respect to the coexistence effect of palatinose and other sugar, there is a report on the relation between palatinose and sucrose

(aforementioned Non-patent Literature 5). According to the report, since invertase ( $\beta$ -D-fructofuranosidase) catalyzes to decompose sucrose into glucose and fructose and is a catalyst recognizing a fructose-binding site of sucrose, it does not catalyze to decompose palatinose having different bond of the same combinations of the constituent sugars to sucrose. Therefore, it is reported that, when sucrose and palatinose coexist, they are catalyzed independently to decompose without mutual influence.

[0013]

On the contrary, isomaltase (oligo-1,6-glucosidase), which is an enzyme catalyzing decomposition of palatinose inside a digestive tract, catalyzes to decompose sugar having an  $\alpha$ -1,6-glucosyl bond such as isomaltose, panose and isomaltotriose. Hence, it is reported that, when palatinose and these sugar coexist, they competitively inhibit decomposition reaction catalyzed by the enzyme one another, resulting in their respective slow decomposition rates (aforementioned Non-patent Literature 5). It has been concluded from the report that, through competitive inhibition by isomaltase, palatinose can reduce the blood glucose level increase caused by consuming saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of 50% or more relative to the total bonds among constituent saccharides. However, palatinose is not supposed to be able to reduce the blood glucose level increase caused by consuming saccharide having no  $\alpha$ -1,6-glucosyl bond including monosaccharide or saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of less than or equal to 50% relative to the total bonds among constituent saccharides.

[0014]

Contrary to the recognition, however, the inventors have found out

a novel phenomenon that, when palatinose is ingested simultaneously with consuming saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to less than 50% relative to the total bonds among constituent saccharides, it can reduce the blood glucose level increase caused by ingesting the saccharide.

[0015]

The present invention provides a method for reducing blood glucose level increase, characterized in that the blood glucose level increase is caused by consuming at least one foodstuff being selected from the group consisting of sucrose, wheat flour, starch, dextrin and high fructose corn syrup, and that palatinose is ingested simultaneously with consuming the foodstuff.

[0016]

Starch and dextrin are catalyzed by  $\alpha$ -amylase,  $\beta$ -amylase and  $\alpha$ -glucosidase (maltase) to decompose to glucose, which is absorbed at small intestine. Palatinose, though having a glucosyl group, is demonstrated to be hardly catalyzed by  $\alpha$ -glucosidase.

[0017]

High fructose corn syrup composed of glucose and fructose, a commercial product of saccharide composed of monosaccharides, is ingested to give a sudden increase and decrease curve in blood glucose level as is seen in sucrose. It has been considered that high fructose corn syrup, which is composed of the monosaccharides, is not competitive as to catalysis by the decomposition enzyme for palatinose and is easily absorbed.

[0018]

It has been generally known that glucose and sucrose cause a sudden increase/decrease curve in blood glucose level. White bread, as well as glucose, is used as a standard because starch in the food is digested at a considerably large rate to show a sudden increase/decrease curve in blood glucose level close to that of sucrose or glucose (Non-patent Literature 4). Dextrin, a partial decomposition product of starch, is easily supposed to draw a blood glucose level curve similar to that of starch. Therefore, sucrose, glucose, starch and dextrin are representative of saccharide which are apt to raise suddenly blood glucose level after ingestion and are used in a wide range of processed foods. High fructose corn syrup, a liquid sugar composed of glucose and fructose which are the constituent saccharides of sucrose, is ingested to show a blood glucose level increase curve similar to that of sucrose.

[0019]

It has been generally considered that, when palatinose giving a mild increase/decrease in blood glucose level and a saccharide (carbohydrate) giving a sudden increase/decrease in blood glucose level such as sucrose, glucose, dextrin or starch are simultaneously ingested, sucrose, glucose, dextrin or starch, which is an easily digested saccharide, causes sudden increase in glucose level as is the case where it is ingested alone, and that slow changes of glucose level caused by palatinose simultaneously ingested is not reflected. The consideration is based on the understanding that palatinose don't cause competitive inhibition because the decomposing enzymes for the above described saccharide, which are easily digestible, are different from palatinose decomposing enzyme , and that palatinose has no influence on the absorption of a



monosaccharide such as glucose.

[0020]

Thus, the invention, that palatinose is ingested simultaneously with consuming at least one foodstuff being selected from the group consisting of sucrose, wheat flour, starch, dextrin and high fructose corn syrup to reduce an increase in blood glucose level caused by consuming the foodstuff, provides a completely novel knowledge.

[0021]

The invention also provides a method for reducing body fat accumulation, characterized in that the body fat accumulation is resulted from the increase in blood glucose level and insulin secretion caused by consuming saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to less than 50% relative to the total bonds among constituent saccharides, and that palatinose is ingested simultaneously with consuming the saccharide. The invention also provides a method for reducing body fat accumulation, characterized in that the body fat accumulation is resulted from the increase in blood glucose level and insulin secretion caused by consuming at least one foodstuff being selected from the group consisting of sucrose, wheat flour, starch, dextrin and high fructose corn syrup, and that palatinose is ingested simultaneously with consuming the foodstuff.

[0022]

increase in the blood glucose level induces insulin secretion. The secreted insulin activates lipoprotein lipase (LPL) which takes part in the uptake of neutral fat into a fat cell. Neutral fat accumulates as body fat. The accumulation of body fat is reduced by suppressing the activation of

the enzyme. It is more difficult for fat to accumulate as body fat when the blood glucose level increases slowly than when the blood glucose level increases suddenly. It is more difficult for fat to accumulate as body fat when insulin secretion changes slowly than when insulin secretion changes suddenly.

[0023]

Hence, palatinose is ingested simultaneously with consuming saccharide to result in a mild increase/decrease curve of blood glucose level, to inhibit activation of LPL and to make accumulating body fat difficult.

[0024]

Furthermore, the invention provides food materials as shown in following (1)-(6).

(1) A food material comprising palatinose and a foodstuff composed of saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to less than 50% relative to the total bonds among constituent saccharides, characterized in that the food material comprises the palatinose in an amount necessary to reduce an increase in blood glucose level caused by consuming the foodstuff.

(2) A food material comprising palatinose and at least one foodstuff being selected from the group consisting of sucrose, wheat flour, starch, dextrin and high fructose corn syrup, characterized in that the food material comprises the palatinose in an amount necessary to reduce an increase in blood glucose level caused by ingesting the foodstuff.

(3) The food material according to the above (2), wherein the food material is used as a sweetener and the foodstuff is at least one foodstuff



being selected from the group consisting of sucrose and high fructose corn syrup.

(4) The food material according to the above (2), wherein the food material is used as a premix material and the foodstuff is at least one foodstuff being selected from the group consisting of sucrose, wheat flour, starch and dextrin.

(5) The food material according to the above (2), wherein the food material is used as a powdery drink and the foodstuff is sucrose.

(6) The food material according to the above (2), characterized in that the weight (A) of the palatinose has a ratio of 5% or more relative to the sum of the weight (A) and the weight (B) of saccharide contained in the foodstuff.

[0025]

Each of the above food material (1)-(6) or a food processed from the food material can be ingested to reduce an increase in blood glucose level caused by consuming the above foodstuff. Each of the above food material (1)-(6) or food processed from the food material can be ingested to reduce body fat accumulation resulted from the increase in blood glucose level and insulin secretion caused by ingesting the above foodstuff.

[0026]

[Embodiments of the Invention]

The invention will be described below in details with respect to preferred embodiments.

Palatinose in the invention, which is also called as isomaltulose, is a disaccharide composed by allowing glucose to make an  $\alpha$ -1,6-glucosyl

bond to fructose.

[0027]

Palatinose may be a hydrate. Monohydrate thereof has a melting point of 123-124°C, a specific rotation  $[\alpha]_{20D}$  of +97.2, a Fehling solution reduction of 52% relative to glucose, and a solubility of 38.4g in 100g water at 20°C. The aqueous solution tastes fine sweet and has about 40% in sweetness relative to sucrose.

[0028]

Palatinose is naturally found in honey or sugarcane juice. It is also found in a product transferred from sucrose by the action of an  $\alpha$ -glucosyltransferase from bacteria or yeasts.

[0029]

Palatinose is industrially manufactured by treating sucrose with an  $\alpha$ -glucosyltransferase produced by a bacteria such as *Protaminobacter rubrum* and *Serratia plymuthica*.

[0030]

In the invention, "saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to less than 50% relative to the total bonds among constituent saccharides" is classified into "saccharide having no  $\alpha$ -1,6-glucosyl bond" and "saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from above 0% to less than 50% relative to the total bonds among constituent saccharides."

[0031]

Examples of "saccharide having no  $\alpha$ -1,6-glucosyl bond" include saccharide such as maltose, sucrose, high fructose corn syrup and glucose. Examples of "saccharide having an  $\alpha$ -1,6-glucosyl bond ratio

of from above 0% to less than 50% relative to the total bonds among constituent saccharides” include isomaltose, panose, isopanose and isomaltotriose etc..

[0032]

5           “Saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to less than 50% relative to the total bonds among constituent saccharides” may be used alone or in combination of two or more. The saccharide includes not only saccharide commercially available as a purified high-grade single component, but also saccharide in a state contained in  
10       cereals such as wheat flour and potatoes. Wheat flour contains saccharide in a content of about 75%. About 98% of the saccharide is starch.

[0033]

15           In the invention, “palatinose is ingested simultaneously with” means that palatinose and one or more other saccharide are ingested during a meal or a between-meal snack. It does not always limitedly mean that they are mixed and ingested. Therefore, it includes ingesting a food or drink containing palatinose and one or more other sugar which easily causes a blood glucose level increase. For example, a case where  
20       a drink containing palatinose is ingested simultaneously with consuming a cake or a cookie containing sucrose and starch corresponds to the condition: “palatinose is ingested simultaneously with” of the invention.

[0034]

25           “Palatinose is ingested” includes ingesting palatinose alone and ingesting a food material containing palatinose , for example, a drink such as a refreshing drink, coffee and black tea, household dishes such as

omelet and cooked dish, confectionery such as baked goods, pudding and bun with bean-jam filling, and breads including a sweet bun.

[0035]

In the invention, “sweetener” means a sweetener prepared for the purpose of coffee or black tea, or means a sweetener for use in household or business. The sweetener may be formed in powder, granule, a cube or liquid. It can be packaged in a stick, a small bag, a box or a portion.

[0036]

“Premix material” means a foodstuff which is sold by previously mixing several materials containing palatinose and one or more other materials including a hot cake mix, a pound cake mix, a bread mix, a pancake mix, a steamed bread mix, a crepe mix, a cookie mix, a doughnut mix, a sponge cake mix, a jelly mix, a pudding mix, bean-jam with sugar and a dumpling powder.

[0037]

“Powder drink” means a cocoa mix, coffee, a powdery juice, a powdered black tea, a powdered lemonade and an instant soup mix. It means a drink product which can be dissolved in a liquid such as hot water, water and milk to serve as a drink.

[0038]

Among saccharide consumed simultaneous with palatinose, sucrose and high fructose corn syrup are sweetener. Therefore, the sweetness can be reduced by substituting a part of the sweetener with palatinose. Since consumers recently tend to like low sweet confectioneries and drinks, these products can be used as foods for such consumers. Alternatively, a highly sweet material such as high fructose

corn syrup, fructose, aspartame, stevia sweetener or acesulfam K can be used together to adjust the product to a favorite sweetness. From the viewpoint of processing characteristics, palatinose in combination with sucrose prevent the food from coloring and prevent low soluble palatinose from crystallization, comparing with the case where palatinose is used alone.

[0039]

It has been proved by the Examples as described below that palatinose, when ingested simultaneously with consuming saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to less than 50% relative to the total bonds among constituent saccharides such as sucrose, dextrin, starch and high fructose corn syrup, reduces an increase in blood glucose level caused by consuming the saccharide.

[0040]

A group of ingesting 50g of sucrose, a group of ingesting 25g of sucrose and a group of ingesting 25g of glucose, which were used as Comparative examples, showed a sudden increase in blood glucose level 30 minutes after the ingesting. As for cases where 50g of sucrose and 25g of glucose were ingested, respectively, the areas of a region surrounded by the blood glucose level increase curve and the baseline (area under blood glucose level increase curve) were nearly identical and high values. And as for the case where 25g of sucrose was ingested, the values were slightly lower. Groups of ingesting 25g of sucrose or 25g of glucose in combination with 25g of palatinose, which were measured as Examples, gave no sudden increases in blood glucose level after consuming these carbohydrates and gave significantly lower values in

area under their blood glucose level increase curves comparing with the Comparative groups.

[0041]

5 The result has revealed that palatinose, when ingested simultaneously with consuming glucose or sucrose, does not work additively in blood glucose level caused by the consumed glucose or sucrose, but reduces reversely the increase in blood glucose level caused by glucose and sucrose.

[0042]

10 It has been also demonstrated that, since palatinose reduces the increase in blood glucose level caused by glucose and sucrose, the result is similarly true when high fructose corn syrup being nearly a sucrose decomposition product, and starch or dextrin being decomposed to form glucose, are replaced with sucrose or glucose.

15 [0043]

[Examples]

The invention will be described below in more detail with reference to Examples, but is not limited to them.

[0044]

20 (Example 1)

25g of palatinose and 25g of glucose were dissolved in distilled water to get a total weight of 190g to prepare the drink (Example drink 1). 25g of palatinose and 25g of sucrose were dissolved in distilled water to get a total weight of 190g to prepare the drink (Example drink 2).

25 Using the drinks as a test sample, a blood glucose level test after ingesting the drink was performed as will be described later. On the



other hand, as a comparative example, 25g of glucose were dissolved in distilled water to get a total weight of 190g to prepare the drink (Comparative drink 1) without mixing palatinose. As a comparative example, 25g of sucrose were dissolved in distilled water to get a total weight of 190g to prepare the drink (Comparative drink 2) without mixing palatinose. As a comparative example, 50g of sucrose were dissolved in distilled water to get a total weight of 190g to prepare the drink (Comparative drink 3) without mixing palatinose. Using the drinks as a control sample, a blood glucose level test after ingesting the drink was performed.

[0045]

The blood glucose level test was as follows. Five healthy volunteers (4 males and 1 female), 31-40 aged, were selected as the test subjects. They took no breakfast on a test day and kept fasting for 12hrs or more before the start of the test. Their bloods were collected before ingesting a drink (0min), and 30min, 60min, 90min, and 120min after ingesting it. As a result their blood glucose levels are determined. One kind of drink was ingested for one test. Another drink was ingested on another day and the test was carried out once a day for total 5 days. The same five test subjects were applied to all the tests for blood glucose levels. In the Example 1, the free style Kissei kit (made by Kissei Pharmaceutical Co., LTD) was used to collect blood samples and test a blood glucose level.

[0046]

The blood glucose level increase curves are shown in Fig.1 to compare the changes in blood glucose level after ingesting each of the

drinks. Fig. 1 reveals that a blood glucose level increase is reduced after the simultaneous ingestion of 25g of palatinose and 25g of glucose, compared with after the ingestion of 25g of glucose alone. A blood glucose level increase is reduced after the simultaneous ingestion of 25g of palatinose and 25g of sucrose, compared with after the ingestion of 50g of sucrose alone and 25g of sucrose alone. Particularly, there is a remarkable difference between the Example drink and the Comparative drink as to a sudden increase in blood glucose level at 30min after ingesting.

[0047]

As shown in Fig. 2, the comparison in averages calculated from the area under blood glucose level increase curves of the each test subject for 120min after ingestion is carried out. As a result, it is revealed that the area under blood glucose level increase curve for the simultaneous ingestion of 25g of palatinose and 25g of glucose was significantly lower than that for the ingestion of 50g of glucose. It is revealed that the area under blood glucose level increase curve for the simultaneous ingestion of 25g of palatinose and 25g of sucrose was significantly lower than that for the ingestion of 50g of sucrose and that for the ingestion of 25g of sucrose. The comparison of the area under blood glucose level increase curves after ingesting each drink is carried out using t-test, which is of correspondency. As a result, it is revealed that the area under blood glucose level increase curve for the simultaneous ingestion of 25g of palatinose and 25g of sucrose was significantly different from that for the ingestion of 50g of sucrose with a risk rate of less than 5%.



[0048]

The above result reveals that the simultaneous use of sucrose with palatinose has an effect for reducing an increase in blood glucose level.

[0049]

5 (Example 2)

Stick sugar containing palatinose and sucrose

10 Palatinose and sucrose were mixed at identical weights, and packed in a stick package by 3.5g respectively per one package. The stick sugar thus obtained is a food material containing palatinose and sucrose for reducing a blood glucose level increase.

[0050]

(Example 3)

Gum syrup containing palatinose and high fructose corn syrup

15 Gum syrup containing palatinose and high fructose corn syrup with the composition as shown in Table 1 below was prepared. The palatinose and gum arabic were joined and powdery mixed, to which the high fructose corn syrup and water were added, then boiled and mixed. The solution thus obtained was adjusted to 30 using a refractometer/Brix meter.

Table 1

component	g
crystalline palatinose (Trade name: Crystalline palatinose-IC, made by Shin Mitsui Sugar Co., LTD.)	27.0
high fructose corn syrup (fructose glucose liquid sugar) (Trade name: EP-O, made by San-ei Sucrochemical Co., LTD., 75%)	48.0
Gum arabic	4.0
Water	200.0

[0051]

(Example 4)

## 5 Tablet containing palatinose and sucrose

A tablet containing palatinose and sucrose with the composition as shown in Table 2 below was prepared. The mixed powder with the following composition was compressed at a tableting pressure of 300kg/cm<sup>3</sup> to make a 18mm diametric, 5mm thick, and 1.5g weighing tablet.

Table 2

Component	Weight%
pulverized palatinose (obtained by pulverizing crystalline palatinose (Trade name: Crystalline palatinose-IC, made by Shin Mitsui Sugar Co., LTD.) by an atomizer)	27.5
powder sugar	27.5
citric acid	1
sugar ester	1
Aspartame	0.05
vitamin P	0.0002
Water	0.6
lemon juice	proper quantity

[0052]

(Example 5)

Powder drink containing palatinose and sucrose

5 A powder drink containing palatinose and sucrose with the composition as shown in Table 3 below was prepared by a conventional method using a universal mixing stirrer.

Table 3

Component	Weight%
crystalline palatinose (Trade name: Crystalline palatinose-IC, made by Shin Mitsui Sugar Co., LTD.)	42.35
sucrose (granulated sugar)	42.35
powder juice	10
anhydrous citric acid	3
sodium citrate	0.4
L-ascorbic acid	0.5
sodium ascorbate	0.3
riboflavin (content 10% by weight)	0.1

[0053]

(Example 6)

10 Refreshing drink containing palatinose and sucrose

A refreshing drink containing palatinose and sucrose with the composition as shown in Table 4 below was prepared. The raw materials were dissolved in 250ml of boiling hot water to fill in a drink can (for 250ml).

Table 4

Component	Weight%
crystalline palatinose (Trade name: Crystalline palatinose-IC, made by Shin Mitsui Sugar Co., LTD.)	4
sucrose (granulated sugar)	4
citric acid	0.15
vitamin C	0.03
sodium chloride	0.05
Potassium chloride	0.04
calcium chloride	0.012
magnesium carbonate	0.002
sodium glutamate	0.006
stevia sweetener	0.01
vitamin P	0.0004
flavoring agent	proper quantity

[0054]

(Example 7)

Sponge cake containing palatinose, sucrose and starch

- 5           A sponge cake containing palatinose, sucrose and starch with the composition as shown in Table 5 below was prepared. Crystalline palatinose, sucrose (granulated sugar) and xanthan gum were powdery mixed to make a mixture called A. Wheat flour and baking powder were mixed to make a mixture called B. Milk and the Ryoto ester SP were
- 10 added to A and mixed thoroughly, followed by adding egg and thorough mixing to become homogeneous, which was warmed up to about 25°C in hot bath. This mixture was bubbled up by a universal stirrer until no more bubble could be generated. The resultant was mixed, with B to make a mixture without kneading B, The mixture was filled in a sponge
- 15 cake tin to bake in an oven at 160°C for 40min. The composition of this Example contained 70g of palatinose, 30g of sucrose and about 90g of

starch.

Table 5

component	g
Egg	200
palatinose powder sugar (Trade name: powder palatinose ICP, Made by Shin Mitsui Sugar Co., LTD.)	70
sucrose (granulated sugar)	30
Wheat flour	120
Milk	41
xanthan gum	0.6
foaming agent (Trade name: Ryoto Ester SP, Made by Mitsubishi-Kagaku Foods Corporation)	9.2
baking powder	3

[0055]

(Example 8)

## 5 Refreshing drink containing palatinose and high fructose corn syrup

A refreshing drink containing palatinose and high fructose corn syrup with the composition as shown in Table 6 below was prepared. The raw materials were dissolved in 250ml of hot water to fill in a drink can (for 250ml).

Table 6

Component	Weight%
crystalline palatinose (Trade name: Crystalline palatinose-IC, made by Shin Mitsui Sugar Co., LTD.)	4
high fructose corn syrup	5.33
citric acid	0.15
vitamin C	0.03
sodium chloride	0.05
Potassium chloride	0.04
calcium chloride	0.012
magnesium carbonate	0.002
sodium glutamate	0.006
stevia sweetener	0.01
vitamin P	0.0004
flavoring agent	proper quantity

[0056]

(Example 9)

Madeleine containing palatinose and starch

5           A madeleine containing palatinose and starch with the composition as shown in Table 7 below was prepared. Wheat flour and baking powder had been mixed and sieved. Butter had been melted in a hot bath. Egg was fed in a ball, to which granulated sugar, kitchen salt, lemon peel and lemon essence were added followed by warming in a hot bath.

10       While warming, palatinose was fed in, and the mixture was stirred thoroughly by a eggbeater. The sieved wheat flour was added at a bulk to be mixed thoroughly and then the melted butter was added to be mixed. The resultant was separated to fill into aluminum foil cups and baked in an oven at 160°C for about 10min until browned. The

15       madeleine prepared by the Example contained 60g of palatinose and about 37g of starch.

Table 7

Component	g
wheat flour (soft flour)	50
baking powder	1
Butter	40
Egg	60
crystalline palatinose (Trade name: Crystalline palatinose-IC, made by Shin Mitsui Sugar Co., LTD.)	60
kitchen salt	0.2
grated lemon peel	proper quantity
lemon essence	proper quantity

[0057]

(Example 10)

Cake mix containing palatines, sucrose and wheat flour

- 5 A cake mix with the composition as shown in Table 8 below was prepared. Materials excluding shortening were previously mixed and then the molten shortening was added and mixed to be sieved.

Table 8

Component	%
wheat flour (soft flour)	33.0
palatinose powder sugar (Trade name: powder palatinose ICP, made by Shin Mitsui Sugar Co., LTD.)	25.0
granulated sugar	9.6
sodium bicarbonate	0.6
sodium pyrophosphate	1.0
Shortening	25.0
skim milk powder	5.0
flavoring agent	0.2
emulsifying agent (Trade name: Ryoto Sugar Ester S-1170, made by Mitsubishi-Kagaku Foods Corporation)	0.1
kitchen salt	0.5

[0058]

(Example 11)

Hot cake mix containing palatinose and wheat flour

5 A hot cake mix was prepared by powdery mixing raw materials with the composition as shown in Table 9 below. Materials excluding shortening were previously mixed and then the molten shortening was added and mixed to be sieved.

Table 9

Component	%
wheat flour (soft flour)	63.0
powder palatinose (Trade name: powder palatinose ICP, made by Shin Mitsui Sugar Co., LTD.)	23.0
baking powder	3.5
Skim milk powder	6.0
flavoring agent	0.2
kitchen salt	0.1
emulsifying agent (Trade name: Ryoto Sugar Ester S-1170, made by Mitsubishi-Kagaku Foods Corporation)	0.1
xanthan gum	0.1
Shortening	4.0

[0059]

10 (Test example 1)

A combination of sucrose and palatinose was ascertained to be more resistant to color than palatinose alone.

[0060]

15 5g of saccharide and 1g of glutamic acid were dissolved in distilled water to prepare a sample having a total weight of 50g. Three kinds of samples were prepared, that is, a sample containing sucrose



alone as the saccharide, a sample containing palatinose alone as the  
saccharide, and a sample containing a combination of 2.5g sucrose and  
2.5g palatinose as the saccharide. These samples were filled in 100ml  
capped vials and then heated at 100°C for 50min. After the heating,  
5 samples were cooled and respective absorbances were measured at a  
wavelength of 420nm. As a result, the sample containing palatinose  
alone as the saccharide gave an absorbance of 0.004, and the sample  
containing sucrose alone gave that of 0.0015, while the sample  
containing palatinose and sucrose by the equal weight gave that of 0.002.  
10 The sample containing palatinose and sucrose by the equal weight was  
more suppressed from coloring than the sample containing palatinose  
alone. This absorbance by the palatinose was a value which allowed a  
user to visually recognize the sample to be colored brown.

[0061]

15 Three same kinds of samples were prepared and treated in an  
autoclave at 121°C for 20min, that is, the same level as in retort  
sterilization for a canned food, and measured the absorbance at a  
wavelength of 420nm. As a result, the sample containing palatinose  
alone as the saccharide gave an absorbance of 0.322, and the sample  
20 containing sucrose alone as the saccharide gave that of 0.020, while the  
sample containing palatinose and sucrose by the equal weight gave that  
of 0.069. The sample containing palatinose and sucrose by the equal  
weight was clearly more suppressed from coloring than the sample  
containing palatinose alone. All the samples were visually colored brown.  
25 But the sample containing palatinose alone as the saccharide had clearly  
deep brown, while the sample containing sucrose alone and the sample

containing both palatinose and sucrose had clearly light brown.

[0062]

It has been concluded from the above result that use of a combination of palatinose and sucrose in a processed food can not only  
5 reduce an increase in blood glucose level caused by the sucrose, but also suppress a heat coloring caused by the palatinose, comparing with use of palatinose alone.

[0063]

(Test example 2)

10 [Suppression of crystallization by simultaneous use of palatinose and sucrose]

A combination of palatinose and sucrose was ascertained to be more resistant to crystallize than palatinose alone.

[0064]

15 A solution containing 50wt% of sucrose, a solution containing 50wt% of palatinose, and a solution containing each 25wt% of sucrose and palatinose were prepared by 100ml respectively, and then they were filled in capped screw vials. Dissolution was performed until no crystal remained at 50°C. These vials were put in a refrigerator set at 5°C to  
20 observe crystallization.

[0065]

After 2 days of storage, the solution containing palatinose alone began crystallization, and after 6 days amount of the crystal was measured. 10.77g of palatinose was demonstrated to have crystallized.  
25 As for the solution containing sucrose alone and the solution containing both sucrose and palatinose, no crystallization were observed during the

days.

[0066]

The above result reveals that palatinose contained in a concentration where it tends to crystallize when used alone dose not  
5 crystallize when it is simultaneously used with sucrose.

[0067]

[Effects of the Invention]

By ingesting palatinose simultaneously with consuming a kind of saccharide such as sucrose, glucose and high fructose corn syrup, which  
10 has an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to less than 50% relative to the total bonds among constituent saccharides, an increase in blood glucose level caused by the saccharide can be reduced. Furthermore, palatinose, when used as a raw material in combination with other saccharide such as nonreducing sugar, can reduce a factor for coloring to  
15 make food resistant to coloring and, when used in a combination with other saccharide with high solubility, becomes not to tend to crystallize.

[0068]

Palatinose, when used in combination with a sweetener such as sucrose and high fructose corn syrup, reduces the sweetness caused by  
20 the sucrose, glucose or high fructose corn syrup, resulting in providing food with low sweetness.

[0069]

When an effect of reducing an increase in blood glucose level is exerted by ingesting palatinose simultaneously with consuming other  
25 saccharide, or consuming food containing a combination of palatinose and other saccharide in the raw material, insulin secretion is also reduced

to result in exerting an effect of reducing a fat accumulation. The invention can be applied to not only human but also a non-human animal (particularly a mammal).

[Brief Description of the Drawings]

5

[Fig. 1]

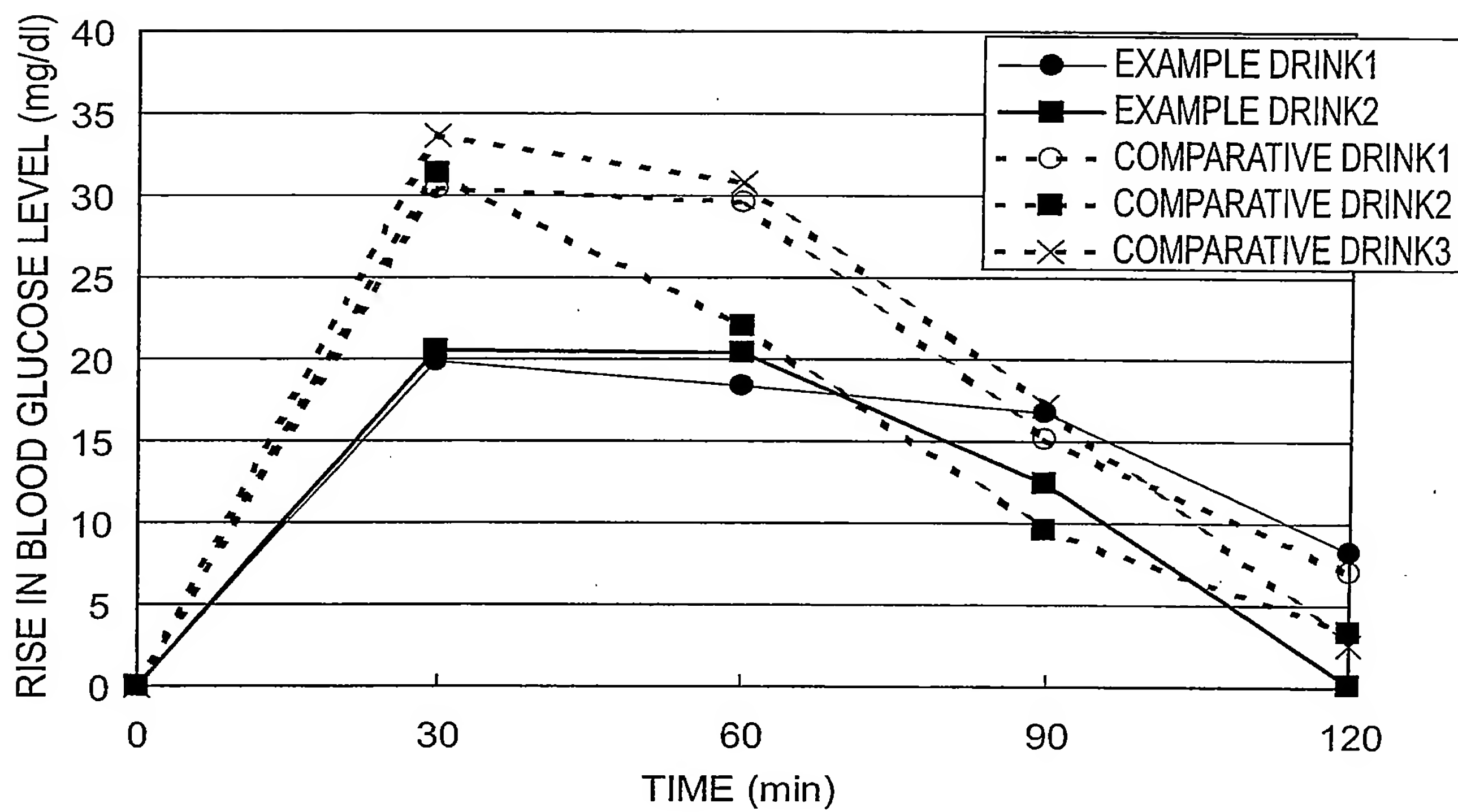
A diagram showing the changes in blood glucose level after ingesting drinks.

[Fig. 2]

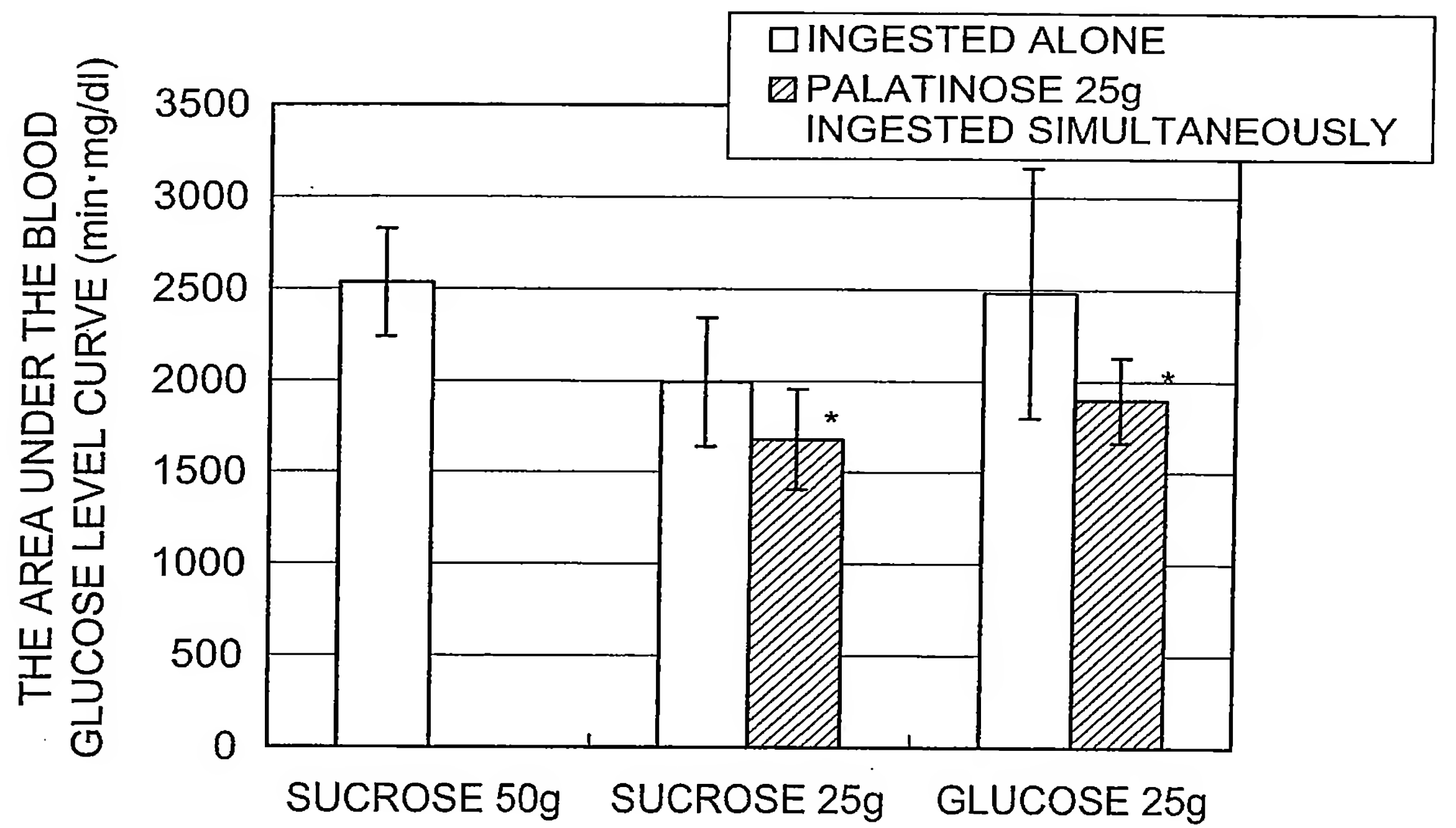
10

A diagram showing the areas under blood glucose level increase curve after ingesting drinks.

**Fig.1**



**Fig.2**



\* A SIGNIFICANT DIFFERENCE WAS RECOGNIZED IN VALUE COMPARED WITH THAT OF SUCROSE 50g  $p < 0.05$ .

[Document Name] Abstract

[Abstract]

[Problem] To provide an effective reducer of blood glucose level increase employing a safe food material usually ingestible.

5 [Means of Solution] A method for reducing blood glucose level increase, characterized in that the blood glucose level increase is caused by consuming saccharide having an  $\alpha$ -1,6-glucosyl bond ratio of from 0% to less than 50% relative to the total bonds among constituent saccharides, and that palatinose is ingested simultaneously with consuming the  
10 saccharide.

[Selected Drawing] None